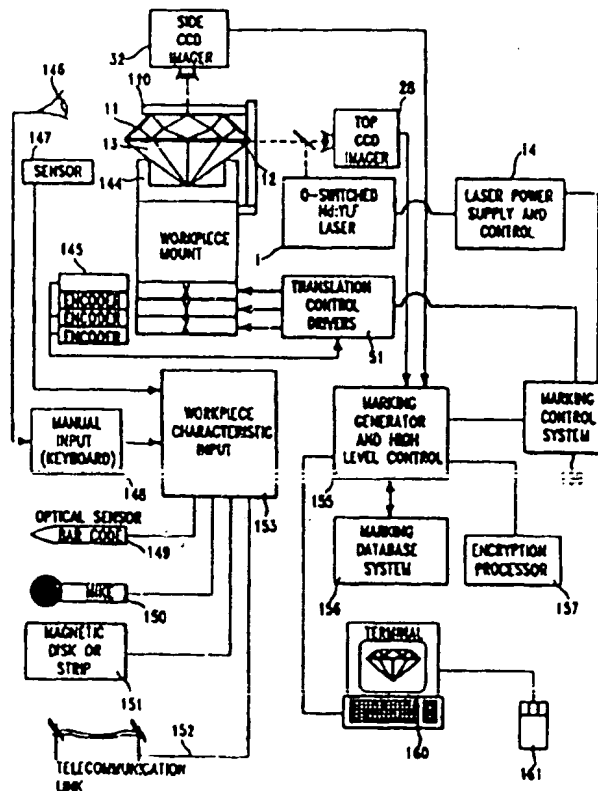


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(57) Abstract

A laser microinscribing system includes a Q-switched Nd: YLF laser (1) with a harmonic converter producing an output of about 530 nm, an optical system including a focussing lens, a gemstone mounting holder (144) that is displaceable along three axes for moving a workpiece (11) such as a gemstone with respect to the optical system so that laser energy is presented to desired positions, an imaging system for viewing the gemstone from a plurality of viewpoints including a top CCD (28) and a side CCD (32), a processor controlling the position of the holder (144) based on marking instructions and a predetermined program, and a storage system (156) for storing information relating to images of a plurality of workpieces. A rigid frame supports the laser (1), the optical system and the holder (144) to increase immunity to vibrational misalignments. A secure certificate of authenticity of a marked workpiece (11) is preferably provided having an image of the marking as well as the outline of a girdle of the gemstone.



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LASER MARKING SYSTEM FOR GEMSTONES AND METHOD OF AUTHENTICATING MARKING

FIELD OF THE INVENTION

The present invention relates to the field of inscribing indicia on a surface of gemstones, and more particularly to a system employing a Q-switched pulse laser for forming markings on a portion of a gemstone.

BACKGROUND OF THE INVENTION

A known system, as described in U.S. Patent No. 4,392,476, incorporated herein by reference, for inscribing diamonds includes a Nd:YAG (1.06 μm , frequency doubled) Q-switched laser which marks diamonds by graphitizing the surface at a laser focal point. The beam position is computer controlled to create overlapping treated regions. The accuracy of known embodiments of this system are limited by vibration and laser steering system accuracy.

U.S. Patent No. 4,467,172, incorporated herein by reference, describes a laser beam diamond inscribing system, which provides a Q-switched flashlamp pumped YAG laser (1.06 μm , frequency doubled) with the diamond mounted on a computer-controlled positioning table for inscribing alphanumeric characters. See also, U.S. Patent Nos. 2,351,932, 3,407,364, 3,527,198, 3,622,739, 3,775,586 and 4,048,515, and foreign patents JP 00-48,489 and JP 00-77,989

U.S. Patent Nos. 5,410,125 and 5,149,938 describe systems which produce a gemstone marking by employing an excimer laser (193 nm) with a masked marking image. Thus, repositioning to form complete characters or graphics is unnecessary. The diamond selectively absorbs the excimer laser radiation and undergoes a partial allotropic transformation without losing its diamond crystal lattice configuration. See also, U.S. Patent Nos. 3,527,198 and 4,401,876. US Patent No. 5,410,125 is a continuation-in-part of Ser. No. 595,861, issued as Pat. No. 5,149,938.

Gemstone News, 11/2/95, "Serial Numbers are Laser Inscribed", and Jeweler's Keystone-Circular, June 1996, pp. 76 relate to gemstones inscribed with serial numbers or markings.

U.S. Patent No. 3,537,198 relates to a method of working diamonds using laser energy. US Patent No. 5,190,024, relates to a diamond sawing process. A laser can be used both to mark and saw the diamond in one operation. See also, U.S. Patent Nos. 671,830,

671,831, 694,215, 732,118, 732,119, 3,527,198 and 4,392,476, as well as Foreign Reference GB 122,470.

U.S. Patent No. 4,401,876 relates to a system for kerfing a gemstone such as a diamond, employing a high energy, high pulse rate, low order mode, laser beam. See also,
5 U.S. Patent Nos. 3,440,388, 3,527,198 and 3,700,850, as well as foreign references BE 877,326, DE 130,138, DE 133,023, GB 1,057,127, GB 1,059,249, GB 1,094,367, GB 1,254,120, GB 1,265,241, GB 1,292,981, GB 1,324,903, GB 1,326,775, GB 1,377,131, GB 1,405,487, GB 1,446,806, GB 2,052,369, Laser Institute of America, "Guide for Material Processing by Lasers" 1978; "Industrial Diamond Review", Mar. 1980, pp. 90 and 91; "Laser
10 Application Notes", 1(1) (Feb. 1979); "New Hyperyag", on Model DLPY 4-System 2000 Yag Laser; and "Diamonds": N.A.G. Press LTD, Chapter Eleven, pp. 235, 239-242.

U.S. Patent No. 4,799,786, incorporated herein by reference, relates to a method of diamond identification provides a method for the identification of diamonds in which a sample to be identified is placed in a beam of monochromatic laser radiation of pre-determined
15 wavelength. The scattered Raman radiation emitted from the sample is passed through a filter adapted to pass only scattered Raman radiation of frequency characteristic of a diamond. The filtered radiation is then detected by the human eye or a photocell device. See also, U.S. Patent Nos. 4,397,556 and 4,693,377, and foreign patent GB 2,140,555, Melles Griot, Optics Guide 3, 1985, pp. 1, 333, 350, 351; and Solin et al., Physical Review B, 1(4):1687-1698
20 (Feb. 15, 1970).

U.S. Patent No. 4,875,771, incorporated herein by reference, relates to a method for assessing diamond quality, by assessing diamonds with a laser Raman spectrometer. The system is initially calibrated by use of diamonds with known quality characteristics, the characteristics having been assessed, for example, by a conventional subjective procedure.
25 Diamonds of unknown quality characteristics are then placed in the spectrometer and irradiated with laser radiation. The intensity of the scattered Raman signal from the diamond is monitored for one or more orientations of the diamond, the resultant signal being a characteristic of the diamond and believed to indicate a quality level of the diamond. See also, U.S. Patent Nos. 3,414,354, 3,989,379, 4,259,011, 4,394,580, 4,397,556 and 4,620,284, and
30 foreign patents FR 643,142, FR 2,496,888, JP 01-58,544, GB 1,384,813, GB 1,416,568, GB 2,010,474, GB 0,041,348 and GB 2,140,555, S. A. Solin and K. A. Ramdas, Raman Spectrum of Diamond, Physical Review vol. 1(4), pp. 1687-1698.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/18448

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I, claim(s) 1-91, drawn to a laser energy microinscribing system.

Group II, claim(s) 92-103, drawn to a method of authenticating a marking on a workpiece by a secure certificate.

The inventions listed as Groups I and II do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: The special technical feature of a secure certificate is claimed in Group II but not in Group I.